PATENT SPECIFICATION

811962

Date of Application and filing Complete Specification: April 15, 1957.

No. 12247/57.

Application made in United States of America on April 26, 1956.

Complete Specification Published: April 15, 1959.

Index at acceptance:—Classes 38(1), E(9A:10X:16:24), G2A1(A:B), G4(A:B:E:F:G:H:K); and 38(5), B1L(2A:7A1:7B5).

International Classification:—H02c, d.

COMPLETE SPECIFICATION

Improvements in or relating to Electric Fusible Devices

We, WESTINGHOUSE ELECTRIC INTERNATIONAL COMPANY of 40 Wall Street, New York 5, State of New York, United States of America, a Corporation organised and existing under the Laws of the State of Delaware, in the United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to electric fusible devices in general, and more particularly, to improved arc-interrupting structures and arc-extinguishing arrangements therefor.

The chief object of the present invention is to provide an improved electric fusible device which will be highly effective in operation and which is inherently current limiting in its action, that is, limiting the short circuit currents passing through the fusible device to a fraction of that available on the circuit at the point of application of the fusible device.

With the above object in view the invention consists primarily in an electric fusible device comprising essentially a tubular insulating casing, an interiorly disposed cylindrical insulating filler member which is helically grooved on the outer surface thereof, a pair of spaced fuse terminals and a cylindrical fusible foil element disposed in the annular space between said filler member and said casing and electrically connected to said fuse terminals.

The basic fuse-unit design as described above may be used by itself alone, or in combination with a series fusible element in a wide variety of different fusible and disconnecting structures. Thus, by merely changing the external supporting arrangement or clamping structure, it is possible to use the same basic fuse-unit design in a wide variety of different fusible structures adaptable for a wide variety of applications.

The fuse unit as described above may be substituted for conventional fuse links in a wide variety of fusible devices.

The invention may also include a series fuse element associated with a current-limiting fuse unit as described above. Such a combination may be substituted for conventional fuse links in fusible structures of the type employing toggle mechanisms for opening.

The invention will become more readily apparent from the following description of exemplary embodiments thereof illustrated in the accompanying drawings.

Fig. 1 illustrates a longitudinal vertical sectional view through the basic fuse-unit design of the invention, the fuse unit being illustrated in its unfused condition;

Fig. 2 is a longitudinal vertical sectional view through a modification of the invention, which incorporates the basic fuse-unit design of Fig. 1, but which, in addition, employs a serially disposed fusible element;

Fig. 3 is a plan view in section taken substantially along the line III—III of Fig. 1;

Fig. 4 illustrates a suspension type of cutout which again employs the basic fuse-unit design in combination with a series fusible element of the type shown in Fig. 2, the several parts being shown in their unfused condition;

Fig. 4A is a fragmentary, enlarged sectional view of the upper end of the cutout of Fig. 4;

Fig. 5 illustrates partially in section, and partially in elevation, an application of the basic fuse-unit design as adapted for a stud connection directly to the bushing of a transformer or capacitor;

Fig. 6 illustrates a vertical sectional view through an enclosed fuse cutout with various parts in side elevation, which again employs the basic fuse-unit design in a widely used commercial form;

Fig. 7 illustrates a vertical sectional view through an enclosed cutout, which utilizes the

basic fuse-unit design, and

Fig. 8 illustrates, in perspective, an open fuse cutout again employing the basic fuse-unit design, with the several parts shown in their unfused, in-toggle position.

Referring to the drawings, and more particularly to Fig. 1 thereof, there is illustrated a fuse cutout particularly adapted for voltages in the class from 2,500 to 15,000 volts, and suitable for a continuous current rating of, say from 1 ampere to approximately 100 amperes but it is to be clearly understood that certain features of the invention may readily be adapted to fuse cutouts of higher or lower voltages and that have different current ratings by suitable modifications of the dimensions and materials.

The features of the new fuse design, as set out hereinafter, enable it to be used on extremely high-capacity systems because the fuse is inherently current limiting in its action, that is, it limits the short-circuit current passing through the fuse to a fraction of that available on the circuit at the point of application of the fuse.

The basic fuse-unit design, as set out in Figs. 1 and 3, employs an outer insulating fuse tube, or casing 1, which for certain ratings, as more fully described hereinafter, will preferably be of a gas-evolving material, such as fibre or boric acid, or similar material of such type well known to those skilled in the art. The tubular casing 1 has an upper fuse terminal ferrule 2, which may be fixedly secured in any suitable manner to the upper end of the casing 1.

Disposed interiorly within the cylindrical insulating casing 1 is a plug, or filler member 3 having a spiral, or helical groove 4 on its outer surface. As more fully described hereinafter, for certain applications the core or plug 3 will be formed from a suitable gas-evolving material such as fibre or boric acid, or similar material, but yet for other applications, it may be made from a suitable non-gas-evolving material, such as porcelain or soapstone.

Threadedly secured, as at 5a, to the lower end of the tubular insulating casing 1 is perforated vent plug 6 constituting another fuse terminal, to which may be secured, as by soldering, a flexible conducting cable 7, the latter leading to any apparatus which it is desired to protect.

Interposed between the inner surface of the casing 1 and the lands, or raised portions 8 of the spirally grooved core 3 is a cylindrical fusible foil element 9, preferably of thin silver, copper or aluminum foil. This foil element is placed in the space between the filler 3 and the insulating tube 1, as shown in Fig. 1. The combined thickness and width and material of this foil member 9 determines the continuous current rating of the fusible device. The clearance between the lands, or raised portions 8 of the spirally grooved insulating filler 3 and the inner bore of the outer insulating tube 1 is very close. Melting or vaporizing of this foil fusible element 9 due to excessive current establishes an arc between the filler 3 and the outer fibre tube 1 extending from the upper metal ferrule 2 to the lower conducting terminal plug 6. The close clearance between the filler 3 and the tube 1 constitutes a very severe mechanical restriction of the arc so formed by the fusion of the metallic fuse element 9. This highly restricted and relatively short electric arc is then provided with an alternate much longer and less restricted path through the spiral groove 4 in the filler element 3. This longer less restricted path maintains the high arc resistance equivalent to that initially present. This continued high arc resistance enables the device to limit the current flowing through the device to a relatively small value. Interruption of the current flowing through this groove 4 is accomplished by deionizing action of the gas blast, which is liberated from the walls of the insulating tube 1 or the filler 3. This gas flows axially through the arc, which is present in the groove 4 on the filler support 3. The interruption of the arc is quickly and effectively accomplished because of the high pressure within the passage 10, provided between the helically grooved filler 3 and the internal bore 11 of the tubular casing 1. Also, considerable turbulence is created by the rapid flow of the gas through the spiral groove 4 and out through the apertures 12 provided in the perforated vent plug 6 in the bottom of the unit.

For low current ratings, such as 5, 10 and 15 amperes, which might be used with small distribution transformers, individual capacitors, and the like, the material used in the insulating tube 1 and in the filler 3 may be fibre, boric acid, or some other suitable gas-evolving material, which evolves gas upon contact with an arc. Gas-evolving materials would be selected in this case in order to insure that there would be a sufficient deionizing gas blast effectively to interrupt all values of current. On higher current ratings of the fuse, because of the higher let-through current permitted by the larger fusible element, less gas evolution may be desirable. In this latter case, the filler 3 could be of some non-gas-evolving material, such as porcelain or soapstone. Likewise, the other insulating tube 1 could be made of some insulating material, such as glass melamine.

Referring to Fig. 2 of the drawings, there is shown a modification of the basic fuse-unit provided with a series fuse 13, which would act very similar to conventional fuse links. As set out in Fig. 2, an additional fibre tube 14 may be threadedly connected, as at 15, to the lower end 16 of the casing 1, with the series fuse element 13 secured, as by soldering, to an apertured vent plug 17.

The two fuses are connected serially, with

the lower fuse 13 in the fibre tube 14 being so calibrated that it will blow prior to the current-limiting element 9 in all cases. Thus, in the event of extremely low values of overcurrent, insufficient to blow the basic fuse unit the series fuse element 13 alone in the fibre tube 14 will operate, or fuse. The resulting expulsion action will remove the connecting cable 19 from the tube 14, thereby providing a means for operating an indicator, or operating a dropout or indicating type of fuse assembly, as more fully described hereinafter. In the case of high-fault currents, both the current-limiting basic unit incorporating the fusible foil 9, and the series fuse element 13 would operate.

Although Fig. 2 shows only one form of the indicator, that is, causing the ejection of the cable 19, other forms will be readily apparent to those skilled in the art. For example, instead of having the cable 19 extend beyond the lower portion of the fuse tube 14, a metal ferrule, not shown, could be attached to the lower end of the fuse tube 14 and the internal cable member 19 attached to a compression spring. This compression spring would separate the series fuse element 13, when it operated under fault conditions and could project an indicating target member below the bottom of the fuse tube to indicate that the fuse had operated.

Fig. 4 shows a possible application of the fusible assembly 18 of Fig. 2 as applied to a suspension-type cutout. As shown, the suspension-type cutout 20 includes a clamp 21 which may be clamped to a transmission line 22, associated with a fuse-unit assembly 18 of the type illustrated in Fig. 2 of the drawings. Thus, the basic current-limiting unit 18 with the series fuse element 13 is connected by the cable connection 19 to a connector 23 extending to a suitable load. The fuse assembly 18 is attached directly to the line conductor 22 by means of the clamp attached to top of the fuse assembly.

As shown in Fig. 4A, the assembly 18 may be threaded through an opening 21a of the clamp 21. A threaded clamping plug 21b holds the assembly 18 fixedly in position, and makes a good electrical connection with the fuse terminal ferrule 2. When the fuse operates, regardless of the current magnitude, the dropout lead 19 is ejected from the lower portion of the fuse assembly 18, thereby clearly indicating to the lineman that the fuse has blown.

Another form of the invention is shown in Fig. 5 of the drawings. Here, the basic unit 5 of Fig. 1 is provided with a modified type of perforated vent plug 6a, which has an extension 24 suitable for clamping by a bolt 25 and nut 26 to a connector 27, which forms part of a transformer or capacitor bushing 28. Preferably, a porcelain weather-housing 29 encloses the basic fuse unit 5, being clamped to the top of a modified ferrule 2a having an upper terminal stud portion 30. A suitable line connection may be made to the stud portion 30 by a clamping nut 31. Preferably, a gasket 32 is utilized, being interposed between the end 33 of the porcelain enclosure 29 and the modified ferrule 2a.

In Fig. 6 of the drawings, there is shown an exemplary application of the basic fuse assembly 18 employed in an enclosed fuse cutout 34. Generally, such an enclosed fuse cutout employs a pair of spaced contacts 35, 36 which are connected by clamps 37 to suitable line connectors, not shown, which extend laterally through the side wall of the porcelain housing 38. The fuse unit 18 is secured to a cutout door 39 having a handle portion 40. It may be threaded through a hollow contact 35a in a manner similar to that of Fig. 4a. A threaded contact plug 35b is preferably employed, which is similar to the plug 21b of Fig. 4A. The cutout door 39 is pivotally mounted upon inwardly extending pivot pins 41 disposed at the lower end of the housing 38 as well-known.

As well known by those skilled in the art, to break the circuit extending between the contacts 35, 36, it is merely necessary to manually grasp the handle 40, and to pull the cutout door 39 outwardly and around its pivotal connection at 41 to open the circuit. However, for automatic protection, the cable 19 of the fuse unit 18 is secured to a clamp 42 forming a part of a toggle mechanism 43. Upon fusing of the basic unit 18, the fuse cable 19 is freed. The toggle mechanism 43 then functions, and the cutout door 39 swings in a counterclockwise direction about the pivotal point 41 to effect withdrawal of the fuse unit 18 from between the contacts 35, 36, thereby providing an isolating gap. Fig. 6 merely indicates a possible application of the fuse unit 18 in enclosed fuse cutouts, which heretofore have employed a universal fuse link extending down through an expulsion fuse tube attached to the cutout door 39. Following operation of the fuse unit 18 in the enclosed cutout of Fig. 6, the complete unit is replaced with a new unit 18, which may be secured to the cutout door 39 in the above-described manner.

Fig. 7 shows another application of the basic fuse unit 5 as applied to a cutout 44. Here, a handle 45 is secured by a cemented stud 46 to the basic fuse unit 5, which has an upper contact 47. This contact may constitute an integral part of the ferrule 2 of Fig. 1. The contact 47 engages a tulip-type contact 48 disposed and cemented into place at the upper end of a tubular enclosure 49. The tubular enclosure 49, which is preferably formed of a suitable weatherproof material, may be clamped into position in the usual manner by a clamping collar 50.

Cemented into place in the lower end of the casing 49 is a second tulip-type contact 51, which makes engagement with a second con-

tact 52 associated with the lower end of the basic fuse unit 5. This contact 52 may constitute an integral portion of the vented plug 6 of Fig. 1. Clamping connections 53, 54 may be made between suitable line connectors and the tulip stationary contacts 48, 51.

To effect a manual operation, one merely grasps the handle 45 and pulls it upwardly, as viewed in Fig. 7, withdrawing the fuse unit 5 upwardly out of the surrounding casing 49. When the cutout 44 is carrying load current, this will establish an arc between the contacts 51, 52 within a gas-evolving fibre tube 55. The evolution of gas within the fibre tube 55 will extinguish the arc drawn between the contacts 51, 52 and the opening motion continues until the fuse unit 5 is completely withdrawn out of the weatherproof casing 49.

To effect contact closure, the reverse operation takes place, namely one inserts the fuse unit 5 and the contacts 47, 52 associated therewith into contacting engagement with the stationary contacts 48, 51 to complete the circuit.

During automatic operation, the fuse unit 5 will fuse and the current limiting action of the fusible foil 9 will take place, as described heretofore in connection with Fig. 1, and the circuit will be broken. It is then necessary to remove the fuse unit 5 by withdrawing the handle 45 upwardly away from the casing 49 so that a new unit 5 may be secured to the stud portion 46 associated with the handle 45. The handle assembly may then be replaced within the casing 49 in the same manner as heretofore described with respect to a manual operation.

Fig. 8 discloses still a further possible application of the fuse unit 18, set out in Fig. 2, as applied to an open fuse cutout. Generally, the fuse structure 56 includes a supporting porcelain 57, secured into a fixed position by a clamping assembly 58, as well known by those skilled in the art. Clamped to the opposite ends of the porcelain support 57 is a pair of contact assemblies 59, 60, to which line connections may be made, as at 61 and 62. The fuse holder 63 will include the fuse unit 18 with contact assemblies 64, 65. Fig. 4A may be referred to in connection with the manner of securing the assembly 18 to the upper contact assembly 64. A toggle mechanism 66 is associated with the lower contact assembly 65 and is maintained in an in-toggle position by the fuse cable 19. The fuse unit 18 is substituted for the conventional fuse link and associated expulsion fuse tube, so that when the fuse unit 18 blows, the cable 19 will be freed and will permit the toggle mechanism 66 to break, thereby resulting in the opening drop-out action of the fuse holder 63.

From the foregoing description, it will be apparent that there is provided an improved basic fuse unit 5, as set out in Fig. 1, which may be used alone or in conjunction with a serially related fusible element 13 of the type set out in Fig. 2. Either the fuse unit 5, or the assembly of the fuse unit 5 with the series fuse 13, constituting an assembly 18, may be employed in a wide variety of different operating structures.

Although the fuse structures set out in Figs. 4—8 are of widely different external form, yet all employ the same basic fuse unit 5 or the basic fuse unit 5 in conjunction with a serially related fusible element 13 constituting an assembly 18, as illustrated in Fig. 2. In all the structures, the current limiting action of the basic fuse unit 5 is present so as to limit the current passing through the fuse device to a small fraction of the short-circuit current available on the circuit at the point of application of the fusible device. Thus, it is possible by use of this invention to use a current-limiting fuse element in the same types of fuses where conventional fuse links had been used before.

WHAT WE CLAIM IS:—

1. An electric fusible device comprising essentially a tubular insulating casing, an interiorly disposed cylindrical insulating filler member which is helically grooved on the outer surface thereof, a pair of spaced fuse terminals and a cylindrical fusible foil element disposed in the annular space between said filler member and said casing and electrically connected to said fuse terminals.

2. A fusible device as claimed in claim 1, wherein said filler member consists of gas-evolving material.

3. A fusible device as claimed in claim 1 or 2, wherein said fusible foil is connected in series with a series fusible element.

4. A fusible device as claimed in claim 1, 2 or 3, wherein said fuse terminals are associated with said casing.

5. A fusible device as claimed in any of the preceding claims, wherein said tubular casing consists of gas-evolving material.

6. A fusible device as claimed in any of the preceding claims, wherein said casing is closed at one end and said closed end is associated with one of said fusible terminals.

7. A fusible device as claimed in any of the preceding claims, wherein one end of said tubular casing is closed by one of said fuse terminals and the other end is associated with an apertured conducting vent plug constituting the second fuse terminal.

8. A fusible device as claimed in claim 7, wherein said apertured vent plug has an extension suitable for clamping purposes.

9. A fusible device as claimed in any of the preceding claims, wherein one of said fuse terminals is associated with a line clamp.

10. A fusible device as claimed in any of the preceding claims 1 to 8, wherein said device is disposed in an enclosed cutout having a pair of spaced contacts electrically bridged by said fusible device in the closed position of said cutout.

11. A fusible device as claimed in any of the preceding claims 1 to 8, wherein said fusible device is disposed in an enclosed cutout and switching device.

12. A fusible device as claimed in any of the preceding claims 1 to 8, wherein said fusible device is disposed in a hinged fuse holder of an open cutout.

13. A fusible device as claimed in any of the preceding claims, wherein said fusible device is removably secured to a terminal at one end.

14. A fusible device as claimed in any of the preceding claims, wherein said fusible device includes a cable electrically connected to one end of said device.

15. A fusible device as claimed in claims 3 and 14, wherein said series fusible element is electrically connected to one of said fuse terminals at one end and to said cable at the other end.

16. A fusible device as claimed in claim 14 or 15, wherein said cable maintains a toggle mechanism in the in-toggle position under tension and breaks said toggle mechanism when said cable is released.

17. A fusible device substantially as hereinbefore described with reference to and as illustrated in the accompanying drawings.

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Leamington Spa: Printed for Her Majesty's Stationery Office, by the Courier Press.—1959.
Published by The Patent Office, 25, Southampton Buildings, London, W.C.2, from which copies may be obtained.

811,962 COMPLETE SPECIFICATION
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SHEET 1

Fig. 1.

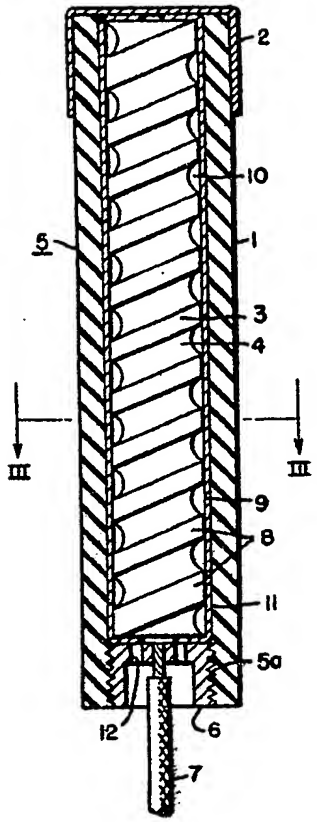


Fig. 2.

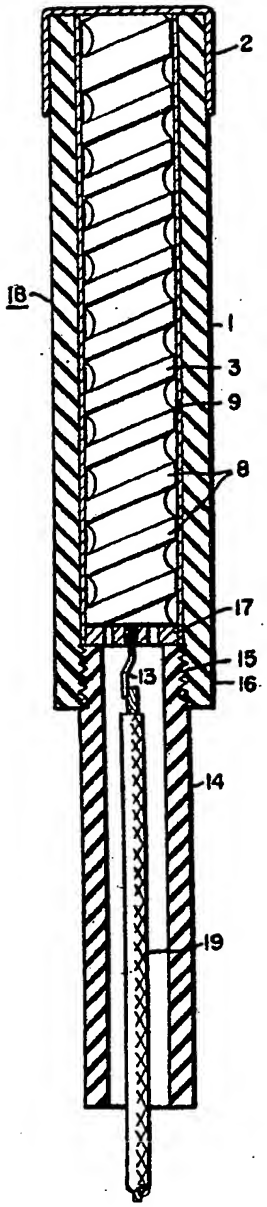


Fig. 3.

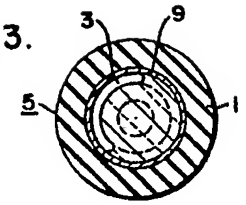


Fig. 5.

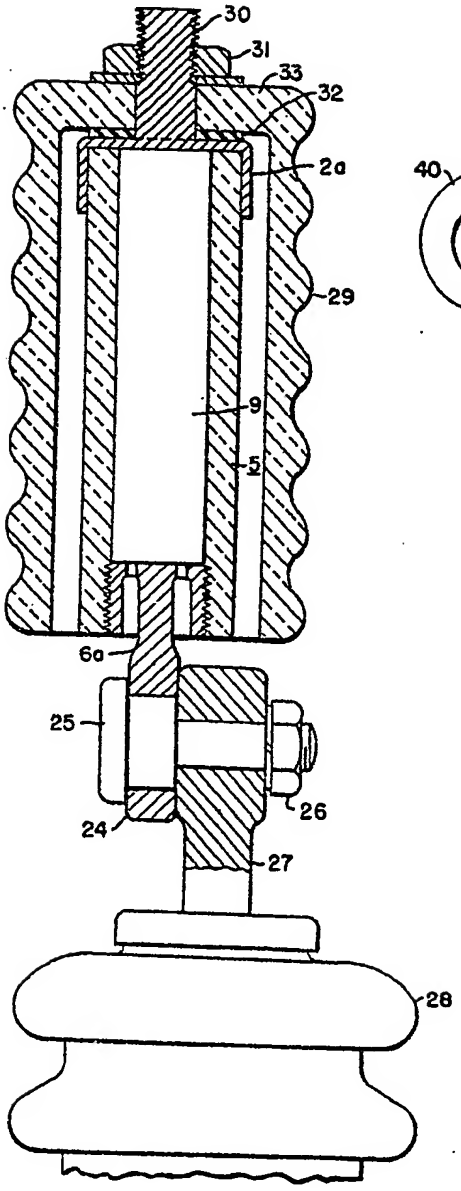


Fig. 6.

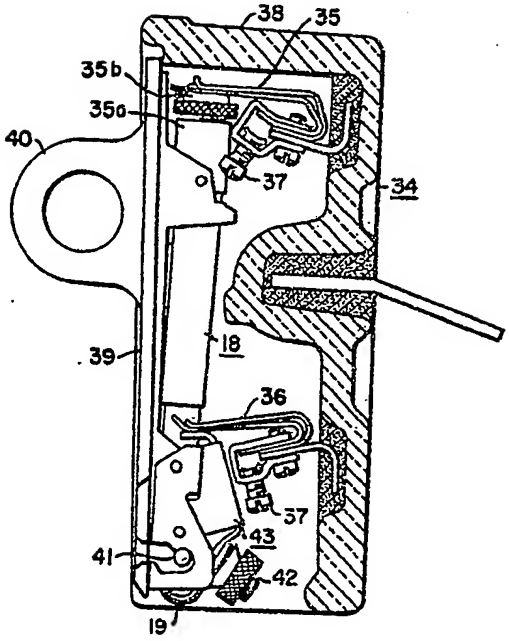
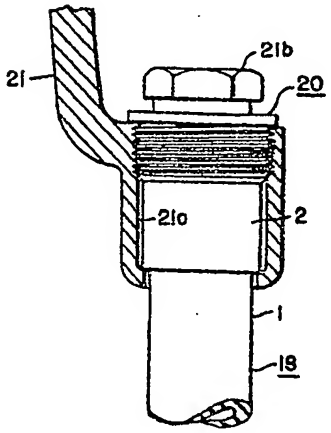


Fig. 4A.



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SHEETS 2 & 3

Fig. 7.

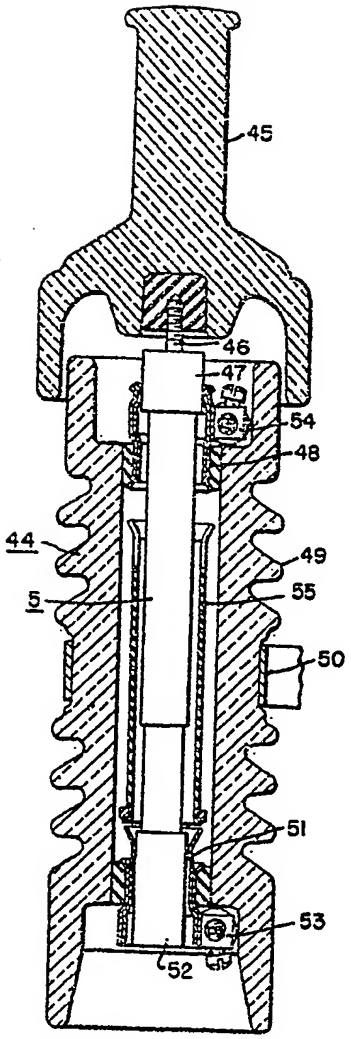


Fig. 4.

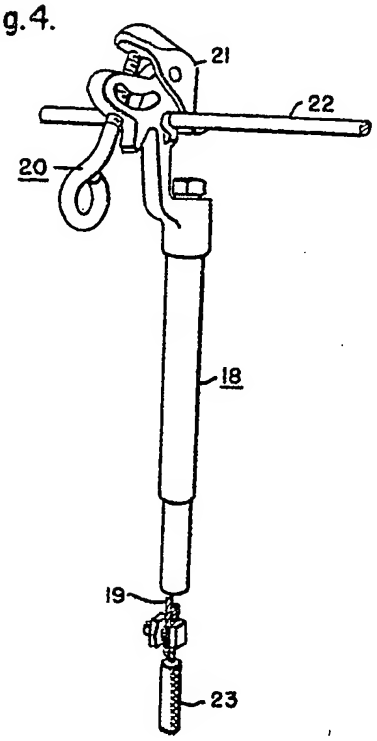
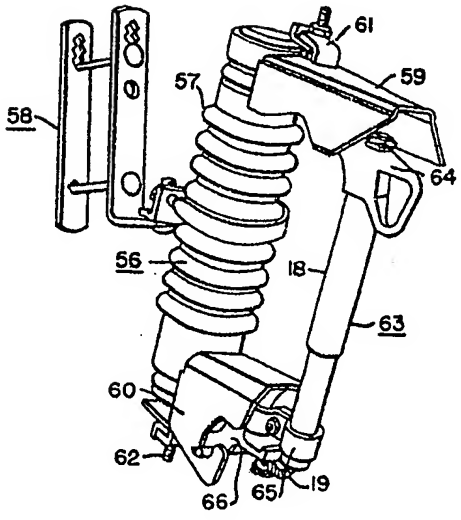


Fig. 8.



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SHEETS 2 & 3

Fig. 5.

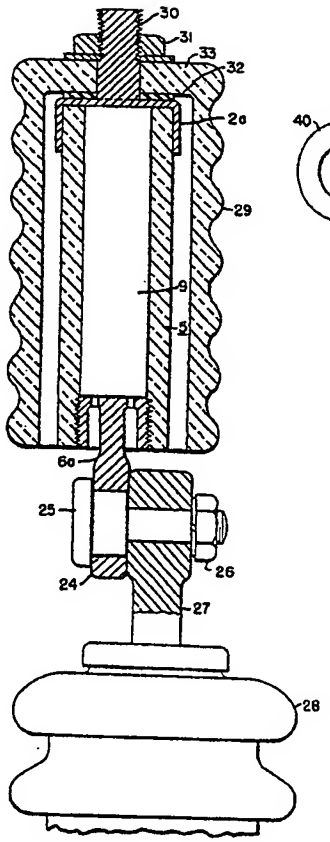

Fig. 6.

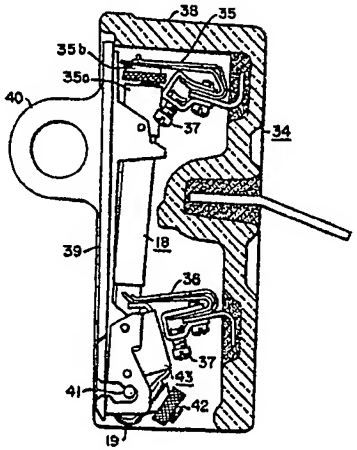

Fig. 4A.

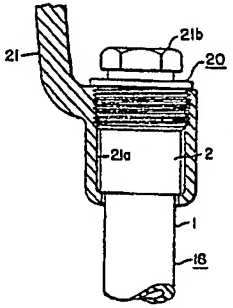

Fig. 7.

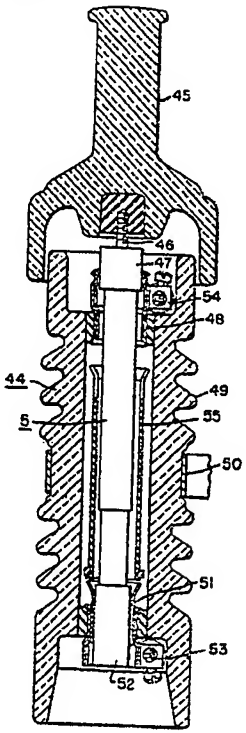

Fig. 4.

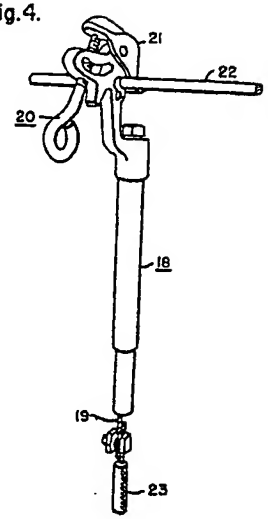

Fig. 8.